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THESIS

THE USE OF INSIGHT IN MANAGEMENT DECISIONS

by

Sorrell Berman

September 1976

Thesis Advisors: J. W. Creighton
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This thesis hypothesizes that insight is the key element in effective decision-making. It aproaches this position by developing a basic model of the environment in which the manager functions, showing the resources at his disposal. It then describes the contributions of the technologies which form the knowledge base for decision-making. Next, it distinguishes between intuition and insight, and demonstrates that it is insight which is the basis for the effective manager's art.

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THE USE OF INSIGHT IN MANAGEMENT DECISIONS

by

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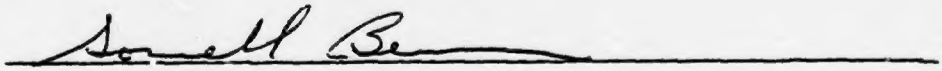
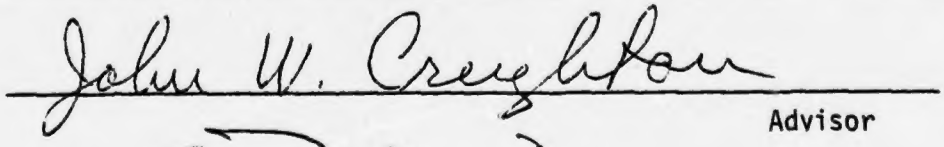
Author 

Approved by: 

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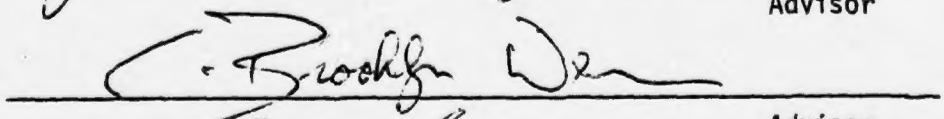

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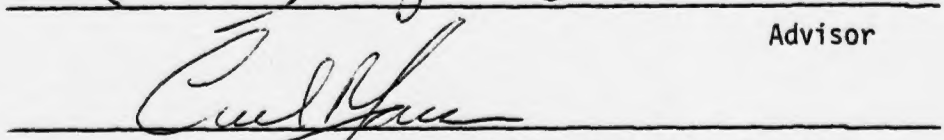

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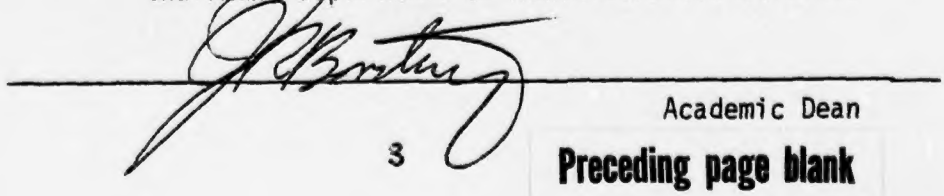

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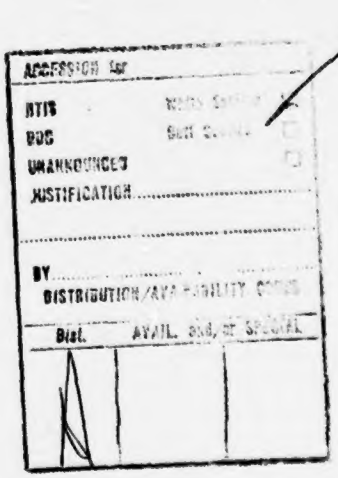
ABSTRACT

This thesis hypothesizes that insight is the key element in effective decision-making. It approaches this position by developing a basic model of the environment in which a manager functions, showing the resources at his disposal. It then describes the contributions of the technologies which form the knowledge base for decision-making. Next, it distinguishes between intuition and insight, and demonstrates that it is insight which is the basis for the effective manager's art.



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I. INTRODUCTION

Decision-making is a complex process involving individual personality, current circumstances, previous experiences and prognosticative talent. Management decision-making is an area in which knowledge of the interaction of these components of decision-making is of great importance. Too little is known about these interactions. Despite this inadequacy, management decisions still must be made. A primary purpose of Management Information Systems (MIS) is to aid in management decision processes. A basic premise of this thesis is that the majority of information systems have been very unsuccessful in accomplishing this goal.

A. OBJECTIVE

The objective of this thesis is to improve management decision-making through better understanding of the contributions of information systems and also of the management decision process itself. This objective will be pursued by considering two sub-objectives: 1) the identification of overt problems stemming from basic personality differences between managers and information specialists and 2) the identification of covert problems stemming from the confusion between intuition and insight and the use of intuition instead of insight as a base for management decision-making.

B. SCOPE

The objectives will be pursued by exploration into the following areas:

1. The environment of the manager; his responsibilities, the resources at his disposal, and his needs in performing his duties.

2. The distinctions between science and management; the philosophical approaches, personality traits and knowledge requirements for the performance of duties by persons in each of the disciplines.

3. The definition of Management Information Systems; the contributions to the manager of these systems, particularly with regards to insight.

II. THE ENVIRONMENT OF THE MANAGER

Usual descriptions of a work environment stress the resources available, commonly referred to as the 3M's, men, machines, and materials. This description ignores the external environment and gives a false sense of stability. The actual world of the manager is highly volatile, and it is the constant need for change which requires decision-makers.

The external environment includes natural situations, such as location, with the associated variations in weather; terrain and the availability of transportation; population distribution, with the associated variations in employment skills; purchasing preferences, leisure activity preferences; and the political and social mores. There is also the competitive situation with the associated distributions of markets and competitor's facilities. Further, there are restrictive situations with governmental regulations reflecting the political and social attitudes. Most of the external environment is beyond the control of the manager; in fact it is usually difficult even to attempt to predict any changes.

These external conditions obviously impact on the internal environment. Such things as Union and Government regulations influence the employment of the workers, the types of machinery employed, and the flow and use of material. To attempt to cope with this environment, there are resources and specialized talents available. To deal with money, there are financial experts. For personnel matters, there are behavioral

scientists. For natural phenomena, there are appropriate engineers. For natural resources, there are mining and logging engineers and natural scientists. For manufactured goods, there are production specialists and marketing specialists. Finally, for the acquisition of knowledge, there are academicians, scientists and inventors.

This then, is the environment of the manager. There are projects to complete, there are resources available, both natural and manufactured, money and people with specialized talents; superimposed on this is an external environment which is usually hostile to the accomplishment of the tasks. There are two further resources that a manager must deal with, these are information and time. The knowledge of the environment is of no use unless this knowledge is transmitted to the manager, and unless time is recognized and utilized correctly, the entire operation may well become an exercise in futility.

There is one final resource--the personal attributes of the manager. Over and above any technical expertise, there must be the desire to deal with the conflict between the external environment and the completion of the projects, and to coordinate the resources so as to accomplish the tasks. One further necessary attribute is the ability to recognize and anticipate the projects which must be done rather than merely satisfying assignments.

An important part of the environment of the modern manager is a Management Information System. This environment is described in section IV. The next section identifies certain

differences between science and management in an attempt to describe and explain interactions between the computer or information specialists and the managers.

III. DIFFERENCES BETWEEN SCIENCE AND MANAGEMENT

A. SCIENCE

1. What is Science?

Before attempting to differentiate between scientists and non-scientists, and even before attempting to define and distinguish the attitudes and attributes of scientists, there should be a consideration of the philosophical aspects of the definition of science. Campbell, in What Is Science? [4], made the following observations:

> Science is the study of those judgements concerning which universal agreement can be obtained. ... Difference of opinion enters not as to subject-matter, but the conclusions based on them. ... The answer is that we are to exclude every particular event from the subject-matter of science. ... Science studies certain relations between particular events.
>
> We examine our past experience, and order it in a way that appears to us most simple and satisfactory; we arrange it in a manner that is dictated by nothing but our desire that the world may be intelligible.

Thus, in this view, to engage in science requires taking "global-views," using the results of particular events as spring-boards to generalizations, distinguishing experimental anomalies from recurring events, questioning the perceptions by our senses, all in an attempt to determine underlying causes rather than individual results.

There is another attitude toward what science is, that of philosophy and metaphysics. This is an attempt to answer ultimate questions and discover universal truths. d'Abro [5] and Duhem [7] do not view this aspect as providing much value. To them, science is not a mere intellectual conjecture on the

nature of things and a search for answers to ultimate questions. It is a pragmatic development of mathematics to describe observed experimental evidence.

2. Who are Scientists?

It is difficult to understand scientists apart from the activity of science. The cause and effect sequence is much like the conundrum of the "chicken and the egg." Does the studious, introverted person become a scientist, or does a scientist acquire studiousness and introversion? In fact, are either studiousness or introversion actual personality traits of scientists? How much do the actions of scientists reflect the expectations of society (including the scientific community itself)? Many personality traits of scientists may be the result of feedback and self-fulfilling prophesies. Knowledge of the stereotype of actions expected may influence the scientist to act that way and thus verify and enforce society's attitude.

Scientists are actually a diverse group of individuals both in their approach to work and their personal habits; however, it seems that there must be something unique in the factors of heredity and environment which produces scientists. Many studies have been conducted attempting to describe and explain such characteristics.

Eiduson [8] has conducted psychological studies on a group of scientists in order ".... to know if there was such a thing as a 'scientific personality'; if scientists could be identified by means other than the ideas they deal with ...." Her findings are summarized as follows:

> Therefore, I feel that this material speaks for a general model of the person who goes into a creative vocation, a model which stems in a large part from the characteristics displayed in mental functioning and to a lesser degree from the psychodynamics and motivational structure of the individual.

Further, Eiduson's study has found some of society's expectations are false. Among such myths she found:

> Contrary to the stereotyped concept that the man of science is very malleable, open to every new stimuli, having a completely open mind, he is selective, discriminative, and quickly recognizes what might or might not be appropriate. ... As a group, they tend to be discriminative and selective, differentiating stimuli in very fine ways, thus making them their own, and also show the same tendencies in their descriptive processes.

Finally, the results of Eiduson's study show "what we see in their cognitive styles is that this is a group of men who grew up as intellectual rebels."

To summarize Eiduson's results on thought processes, the scientist is a puzzle solver. He attempts to bring order out of chaos and does not like to be bound by accented procedures when solving the problems.

Another facet of scientists which Eiduson attempted to categorize was personality. Some of her important conclusions are:

> Commonality of isolation may not seem significant in itself. What is important, however, is that such experiences invariably led scientists to look to their own resources for solace and amusement. ...
>
> The scientist became then not so much a man in search of truth as a man who is permitted, forgiven, even encouraged and praised for making so many false statements--so long as he did not abandon his basic value for truth. ...
>
> Most scientists carve out degrees of freedom for themselves with marvelous ingenuity and imaginativeness. They are few who believe that research can be stifled by even the most adverse external conditions.

Eiduson's results are very revealing. The thought processes and personalities of scientists are described in distinct but qualitative terms. The results confirm the tendencies in thought processes which are consistent with the personalities of the scientists. A complete list of the characteristics in thought processes and personality is included as an appendix.

B. MANAGEMENT

1. What is Management?

In contrast to the disagreement as to what is science, as viewed by philosophers, metaphysicians, and scientists, and further, the disagreement even among various metaphysicians and various scientists as to a definition, there appears to be no disagreement when an attempt is made to ascertain what is meant by "management." This is not because there is no divergence of opinion, it is because there appears to be a lack of a clear definition. Almost all agree on what it is, whatever it is.

As Drucker [6] states:

> What management is supposed to do and how it should be doing it are subjects which are rarely discussed. This oversight is no accident. It reflects the absence of both a tenable theory of business enterprise and an adequate discipline of management.

Concentrating exclusively on production and manufacturing, Taylor developed in 1911, the concept of "Scientific Management." This was an optimizing, rational breakdown of the functions of production so as to maximize output. This was

an engineering approach, with the worker viewed as part of the production process. Thus, management was entirely task oriented. In 1916, Fayol introduced the basic functions of management.

The task orientation was still predominant. From the viewpoint of systems theory, this would correspond to the analyzing phase. The concepts of Taylor and Fayol still dominate much of management theory. Apparently, the synthesis aspect has not been developed sufficiently. Even the behavioral school merely presents another facet of the analysis.

At present there are two main approaches to modern management theory; the behavioral school, and the process or functional school. There are three subcategories of the functional school, the quantitative and decision schools and the empirical school. The empirical school is considered as part of the process theory and the quantitative and decision schools provide measurement techniques for both of the major categories. The differences between the two schools is most easily understood in terms of McGregor's Theory X and Theory Y (see Drucker [6]).

Other major contributors to the behavioral school include Maslow, who developed a classification called the "hierarchy of needs"; Argyris who concluded from his studies that, contrary to the assumptions of Theory X, mature people resent the constrictive control of the typical business organization; Herzberg who has refined the concepts of Maslow, McGregor, and Argyris by defining specific factors under the

control of management that are important in motivation. He has defined two types of categories: "hygiene factors" and "positive motivators."

A recent theory of management is called "contingency management." This school proposes that the type of management to be practiced should be determined by the specific task and the composition of the workers involved.

While the different schools of management are holding academic debates as to the relative mertis of each, business must be done. As Drucker states, "the manager cannot wait till the scientists and scholars have done their work. Nor can the worker. The manager has to manage today."

An important function of management, frequently only alluded to, is decision-making. The theories of the different schools of management provide methods of analysis and different criteria for evaluation of the benefits of various alternatives. The process school attempts to reduce decisions to those optimizing production. The behavioral school concentrates on interpersonal relations. Management, then, may be viewed as that function which produces optimal utilization of all resources, both animate and inanimate, considering the trade-offs between production degradation (which is usually a short run phenomenon) and the amount of dysfunction in the workforce (which may last long past any particular project). This optimization is not a rigorous mathematical process, and should not be. It depends, in essence, on the utility function of the decision-maker. Some of the personality traits which contribute to this utility function are considered next.

2. Who are Managers?

A greater confusion than that between science and scientists exists in distinguishing management and managers. There are many theories as to who a manager is; these are mainly normative, i.e., relating how the manager is supposed to act. When actual characteristics are reported, they usually include the adjective "successful," which is a very value-judgemental modifier. This could also lead to circular reasoning: having assumed what success is, then the characteristics are chosen.

An important function of managers is described by Drucker [6]:

> The effective decision-maker either acts or he doesn't act. He does not take half-action. This is the one thing that is always wrong.

Argyris [2] describes a problem area:

> Unfortunately our studies so far indicate that the majority of managers still do not know how to use the models as the basis for creative experiments. This is partly due to the fact that experimentation, risk taking, and trust have been drummed out of our managerial systems. This assures that just those men who do not enjoy experimenting will become managers.

Sayles has attempted, by observation and interview, to find the actual performance of current managers. He has shown that many of the long held concepts of management are no longer valid. Sayles [10] relates:

> From the studies of the organization produced by the second industrial revolution, it is clear that some of the older management myths have to be discarded in light of the realities of the contemporary organization. ...
>
> Management principles have been based too heavily on organizations that no longer exist or at least are diminishing in importance.

Sayles has discovered that many of the conditions under which the manager must work actually are in direct conflict with desired attributes. For example, the manager is expected to create an organization to accomplish his objectives. Frequently, however, his own position, authority and responsibilities are ill-defined. Further, the manager is expected to display improvisation and flexibility, yet the system which provides guidelines for his responses is usually inflexible. Thus, the manager must continually grope and probe for methods with which to deal with his subordinates and, more importantly, his work environment. As Sayles states:

> Only managers who can deal with uncertainty, with ambiguity and battles that are never won but only fought well, can hope to succeed. The success must be measured by the manager's managers in terms of the ability to maintain the system as an on-going organization rather than to achieve some abstract "victories."
>
> •
>
> The essence of management is not of heroic proportions. Rather, most managerial behavior is mundane, and frustrating. As we have seen, it involves endless negotiations, trades, and bargaining; and redirection of one's own and one's subordinates' activities in the light of the information derived from monitoring.

A manager should not be the stereotyped harried executive, constantly inundated with critical decisions, requiring immediate "yes-no" answers. However, this is an atmosphere in which many persons called managers perceive themselves to be. To function effectively, it is clear that the manager has to be able to plan in an atmosphere of uncertainty, understand the impact of alternatives on the internal and external environments, and most importantly, have the innate ability to realize the time frame in which a decision must be made.

C. EXPLICIT DIFFERENCES BETWEEN MANAGEMENT AND SCIENCE

In addition to considering some individual attributes of science and management, certain comparisons are very instructive. Eiduson [8] states:

> I chose individuals in business for this third group not because work in business is necessarily uncreative; the growth and development of American industry would certainly attest to the inventiveness and creativity there. But the business fields, unlike the creative fields of the arts, do not state that originality and creative talent are the most highly prized and valued characteristics.

Even Campbell [4] refers to some of the misunderstandings:

> The practical man is apt to sneer at the theorists; but an examination of any of his most firmly-rooted prejudices would show at once that he himself is as much a theorist as the purest and most academic student. ...
>
> It is the practical man and not the student of pure science who is guilty of relying on extravagant speculation, unchecked by comparison with solid fact.

As indicated by Drucker, while the practical man or businessman may be a victim of false theories, time may not permit awaiting the final validation. Waiting may be more disastrous than a wrong decision. A bad decision usually creates a suboptimal condition and one of man's great contributions is the ability to perform corrective actions. However, non-action may result in the discontinuance of some function, and once stopped, there may not be the capability to reestablish it. Conversely, stubborn continued use of outmoded practices because of tradition produces great waste. The balance between these two should be an area in which theories of management and the experience of the manager combine to provide better decisions.

Argyris [3] discusses an inherent conflict:

> The position taken by scientists and philosophers of science (is) that the underlying spirit of scientific research is the spirit of inquiry. It is the irresistible need to explore the hypothetical spirit. The norm to be open to experiments is also crucial in the spirit of the inquiry. If we compare these conditions with those found in the living systems of organizations (as described in our models), we find that the organizations tend to create the opposite conditions. For example, it has been shown that interpersonal oneness, experimentation, and trust tend to be inhibited in organizations.

A complete list of the results of Eiduson's [8] comparisons of scientists and businessmen is included in the appendix. A few of the more significant areas are: (The scientist)

> Seeks to depart radically in his expressions and thinking from the usual, obvious, or hackneyed.
>
> Interests point to the theoretical and abstract rather than the practical.
>
> Accepts reality but sees it in a way different from others.
>
> Can tolerate ambiguities in the perceptual area.
>
> Does not imitate and depend on others in thinking and action.
>
> Is challenged by frustration and anxiety-producing situations rather than being overwhelmed by them.
>
> Is sensitive to his internal environment, needs, wishes, desires.
>
> Seems strongly self-directed and self-disciplined.

It is instructive to compare the stereotyped business atmosphere of a pyramidal structure with reliance on standard operating instructions and precedence with this list of personality traits of scientists.

In simple terms, the difference between science and management is that the primary purpose of science is to experiment and explore; that of management is to produce. In line with this, scientists are game players and system avoiders, while managers must develop and design systems. Finally, while

scientists may usually experiment in relative privacy, the manager must work in public.

Given these differences in science and management, the next stage is to examine the impact of these differences on decision-making.

D. DIFFERENCES IN DECISION-MAKING

The problem-solving approach to scientific or managerial decision-making is identical:

1. Isolate and define the problem.
2. Determine the alternative available inputs.
3. Process the inputs to obtain the possible outcomes with the associated probabilities of occurrence.
4. Choose the "best" alternative.

The major decision process is actually step 4, choosing the "best" alternative. The actual implementation of the process is much different for each of these different disciplines. Some of the major differences appear in:

1. The formulation of assumptions and hypotheses.
2. The degree to which the problem is well-defined.
3. The ability to discern the "disease" from the "symptoms."
4. The extent of quantitative vs. qualitative objectives.
5. The degree of knowledge of the totality of the available inputs.
6. The degree of knowledge of the process and the interrelationships between the inputs.
7. The ability to determine the outcomes, and particularly any associated probabilities.

8. The degree to which standards exist to compare the alternatives.

Typically, modern scientific problems evolve as extensions to some previous experimental evidence. The formulation of the assumptions and hypotheses is a rigorous process. The problem is usually well defined or at least is restricted to a very narrow area. The problem is stated in the form of mathematical relationships and experiments are performed to validate the theoretical predictions. If the experimental results do not match the desired results, the assumptions and hypotheses are reviewed and possibly adjusted, and the experiments repeated. This process is iterated until the theory and experimental evidence agree or the theory is determined to be valid.

In contrast, for many managerial problems, little consideration is given to identifying explicitly the underlying assumptions and hypotheses, and in the worst case, fuzzy forms of tradition are used. Further, documentation of assumptions is usually quite minimal. The problem is of broad scope with limited knowledge of the totality of the inputs and particularly the interactions existing between any of them. The problem may well be stated in qualitative terms with some "what if" situations proposed. A "decision" is reached and the results observed, but again there may be no documentation (other than financial) of the results.

Differences also exist in the repeatability of the situations, the time usually allotted to the decision-making process, and the types of risks involved. The essence of

scientific investigation is to limit the environment so as to maximize the repeatability of any experiment.

Many scientific investigations are financed by large agencies both public and private. The investigators have little contact with the funding process and in fact to do so might lower their scientific standing. Further, once the money is allocated the success or failure of the project may not affect future allocations for other projects, and not even future employment may depend on decision end results. The primary risk is the damage to the ego, the risk of committing to a project or idea which fails.

In contrast, many managerial problems are caused by uncontrolled elements in the environment. Further, the problems do not usually lend themselves to experimental procedures. Finally, managerial decisions deal with the least reliable and most unrepeatable resource, people. Even if it were possible to control all other elements of the environment, just the passage of time means that once stimuli have been impinged on people, they are different and there is no way to repeat the experiment, There is no way to get "exactly the same" people from another group. They may be similar but obviously are not the same. Next, all too often the "moment of decision" for management may be just that. Due to real or imagined pressures the answer to a business or management question traditionally has required it be given "decisively." To do less apparently showed some lack. The risks involved are also much different. While most decisions do not involve physical risks, any that do would more

likely involve some workers and not the decision makers. The majority of management decisions involve use of local funds and choices of investment. If the decision is wrong, money is lost which could result in the loss of employment for not only some of the lower level workers but also the higher level workers and even decision makers. Possibly the entire organization may fold following a horrendously bad decision.

One of the basic differences between scientific and managerial decisions is in the ability to assess that an answer is "correct." Typically, a "right" managerial decision has been designated as one which leads to a net positive outcome. However, there is a great need to differentiate between the solution to a problem, a decision, an action, and the outcome. The outcome of a perfect solution, which led to a perfect decision, which in turn, was implemented, by perfect action may be judged as "wrong," due to uncontrollable elements in the environment. A classic example occurred on the stockmarket prior to the advent of computers. An investor determined that there were certain stocks and associated time periods in which to buy and sell "short." He contacted his broker with instructions as to which to do and when to do it. The broker placed the orders as directed and the stocks performed as predicted. Thus, the investor should have reaped great gains. Unfortunately, the time delays in processing the orders were such that the actual transactions were totally out of phase; and the investor actually lost a great deal of money. There was no way the processing time delay could be determined so that it could

be included in the investment strategy. Conversely, there are innumerable examples in which a desired outcome has occurred as the "lucky" result of a theoretically improper process.

It is even more difficult (if not impossible) to deal with the concept of optimality when assessing managerial decisions. This is further compounded by difficulty in demonstrating cause and effect. In management problems, frequently the determination that a particular outcome is the direct (or even indirect) result of an action is very tenuous. Thus, optimal actions, even when viewed after the fact, are difficult to determine. Finally, although game theory and simulations can be performed, the actual decision is made and the resulting actions performed in "real time" in the "real world"; and thus, the particular problem is usually a "one-shot" situation, never to occur again.

The preceding is a simplistic view of scientific and management decision-making. The differences are obviously not as sharp and distinct as described. The excellent manager does not perform so as to have all the disadvantages that were reported. However, the differences were considered from a worst case approach so that the problems were those confronting the less enlightened managers. Thus, alleviations of these problems would be aimed primarily at assisting such managers in improving performance.

One approach to improving management decision-making is the introduction of a Management Information System. This is discussed in chapter IV.

IV. THE ENVIRONMENT OF A MANAGEMENT INFORMATION SYSTEM

Whatever the problems involved in science or management, or in the interactions between scientists and managers in society or in a work environment, these problems are amplified in the microcosm of a Management Information System (MIS).

A. DEFINITION OF MANAGEMENT INFORMATION SYSTEM

Alexander [1] gives a general view:

> A management information system may be defined as any information system that provides a manager with information on the activities and pertinent interrelationships about the current status of the production/operation system over which he has authority. From this basic definition, the basic system objective is evident: namely, to provide the manager with complete, accurate, and timely information relating to the performance of the organization.

Elliot and Wasley [9] have a more restricted definition:

(1) Management performed with the aid of automatic data processing.

(2) A data processing system designed to provide management with the information needed to manage and supervise a particular agency or function.

Due to the size and complexities of most organizations, and in an attempt to provide timely information, most systems include the use of digital computers; this paper will assume the use of a computer in the definition of an MIS.

B. CONTRIBUTIONS AND CONFLICTS

These definitions of MIS reveal what the contributions of the MIS should be. However, for each area of contribution, there currently are conflicts which arise.

The reason for an information system is to assist in the decision-making process. Drucker [6] describes some features of decision-making:

> Decision-making, further, is not an intellectual exercise. It mobilizes the vision, energies, and resources of the organization for effective action.
>
> Strategic planning does not deal with future decisions. It deals with the futurity of present decisions. Decisions exist only in the present.

Sayles [10] comments:

> More realistically, decision is an organizational process. It is shaped as much by the pattern of interaction of managers as it is by the contemplation and cognitive processes of the individual.

A vital part of any organization, and of critical importance to an MIS is valid information. However, there is disagreement as to what constitutes valid. Invalid data is usually easy to identify, as Duhem [7] relates:

> As the French mathematician Betrand once said, "the age of the captain, the number of the crew, the height of the mast can yield no information about the position of the ship."

Argyris [3] observes: "valid data for an MIS would reveal to many managers how much has been hidden all these years." Further, there is the underlying structure of the MIS, as Argyris reports, "an MIS, like any formal bureaucracy, is based on the assumption that organizations are, and should continue to be, rational." The reason for this, he observes, is:

> A major assumption of information scientists is that if "real life" situations can be adequately modeled (with valid inputs to a computer model), then action will be more effective. To put it another way; more and more complex decisions can be influenced by rational thought.

It should be noted that the striving for rationality and for the inclusion of the workings of the informal organization

as valid information are in serious conflict, since the informal organization probably violates the information specialist's view of rationality. Thus, the introduction of an MIS may initially worsen the decision-making process. As Argyris [2] describes:

> The new information science technology is usually introduced by fanfare that creates unrealistic expectations and is managed by a group of "whiz kids" who genuinely are interested in changing bureaucracy, but who use the system to control and direct people with even greater precision and pressure.

This is confirmed by Drucker [6] :

> When NASA first started, the scientists who dominated it believed that controls, especially of course, computer-based information, would run the system. They were soon disabused.

Drucker presents another problem:

> Communication and information are different and indeed largely opposite, yet interdependent. Where communication is perception, information is logic. As such, information is purely formal and has no meaning.

Thus, another function of an MIS is to provide the vehicle for the conversion of information to communication. However, as Argyris [3] reports:

> The final human impact of MIS is that it requires managers with higher levels of intellectual and conceptual competence. They must be able to deal with the interrelationships among the facts. Typically, this is not a skill possessed by many executives.

This, then, is the atmosphere in which most managers and computer and information specialists operate either in the development stages of an MIS, or trying to cope with an existing one. Each is trying to provide the best decisions possible, but in many instances they are working at cross purposes.

The importance of an effective MIS cannot be overstated, for as Argyris [3] proposes, "develop valid management

information technology and you rule the world." While this statement may have been made facetiously, the grain of truth is there. Once again the important word is "valid."

A prime consideration in the development and determination of what information is needed for management decision-making and the MIS is the interaction between the manager and the computer or information specialist. The next section describes an area vital to this communication process.

V. THE ROLE OF INSIGHT IN DECISION-MAKING

One of the psychological aspects of decision-making requires special emphasis and development. It is the psycho-physiological process involved in learning and problem-solving. Many years of research have been devoted to this subject, but as yet no satisfactory, definitive theory has been developed. The area most pertinent to decision-making, that of the solution to a problem, has been the most baffling. There are some accepted theories as to the mechanisms of the brain by which information is stored, and some aspects of the processing and restorage. However, there is as yet no reasonable theory for the process by which the processed information is recalled, often involuntarily, to solve a problem, which in many cases has long since been forgotten. Psychologists are attempting to correlate computer simulation models, physiological measurements and psychological tests to describe this mental process. One concept is that of "satisficing." This reflects the tendency of people to accept as a solution anything above a given threshold and not to strive for an optimum solution, or even take the time to determine if optimal solutions exist. This tendency toward sub-optimization can be associated with intuition, the quick response to a question based primarily on immediate personal feelings. Whatever the inherent process of human beings, the optimization usually required in management decisions will not be obtained without some formalized structure, and this is precisely the purpose of the MIS. This optimization can be associated with insight, the studied answer based on experience.

To demonstrate the complexities involved in decision-making, and to highlight the difference beween intuition and insight, the following example is given.

A. DECISION-MAKING: AN ILLUSTRATIVE EXAMPLE

It is an oft quoted saying among managers that a good manager is one who guesses right 51% of the time. If this is true, could not most managers be replaced with some type of statistical model? Also, management involvement in MIS and the success of information systems in satisfying management's needs have been almost universally unsuccessful. There is an interrelation between these two situations, the methods of constructing statistical decision models has a large impact on the effectiveness of the MIS.

Before addressing the preceding conditions directly, an extreme example will be considered:

> It is reported that a coin has been tossed 100 times, with the result 99 heads and 1 tail. What can be inferred from such information, and how will this information be used to bet on the next toss?

The manner in which people respond to these questions depends on a complex combination of education, experience and possibly even heredity; this combination is usually called "intuition." At one extreme would be the persons who rely entirely on the report of the experimental evidence. Thus, for them the odds are 99 to 1 and the bet on the next toss would be unhesitantly for heads. At the other extreme would be the persons who have learned that the tossing of a "fair" coin represents "independent" events. Thus, from the definition of

"independent," the probability for the next toss does not depend in any way on the previous tosses; further, from the definition of "fair" the odds on any one toss are heads ½, tail ½. For this group, the only relevant information is that a coin will be tossed; the experimental evidence is totally ignored.

Most people would not be at either extreme; although they have become accustomed to the odds on coin tossing of heads ½, tails ½, they would try to modify these odds by attempting to incorporate the results of the previous tosses. Here, too, there would be diverse reasoning for the bet on the next toss. If the experiment is taken as evidence of an unfair coin, the bet would be towards heads; however, it is believed that the coin actually is fair and the results were merely a fluke and further that "nature" tends toward equilibrium, then the bet would be on tails.

In this example, while the choices for the next bet are limited to a head or a tail, most people could not explain the process responsible for their choice. Neither could they give reasons for the odds they would give. It would be looked upon as a gamble and a guess. Further, since nothing was at stake in this hypothetical example, the time taken to make the choice would be quite short and there would not be much agonizing over a wrong guess.

If the bet were real and involved considerable sums of money, most people would hesitate, procrastinate, demand highly favorable odds and many would not play at all. This phenomenon is discussed at length in statistics courses and is called "utility," relating to the risk averseness of most people.

Utility is an important concept as a view toward individual attitudes toward decision-making. (See Schlaifer [11].)

There are some people who might not want to bet even in this hypothetical case, their reason being lack of sufficient information. These people are usually called "indecisive" or "procrastinators." A closer examination of the example reveals that this is exactly the case. All that can be inferred from the report is that the coin has at least two sides. Anything else is a result of conjecture, supposition, and assumption. There is nothing in the report to limit the coin to two sides. Further, there is nothing reported as to the physical dimensions of the coin or its symmetry, such knowledge could be used to estimate the degree of fairness of the coin itself. Also, no mention is made as to the mechanism used to toss the coin, this could relate to the fairness of the outcomes, as well as the degree of independence of the tosses. It would appear that a prudent person would attempt to consider all such questions and obtain as many answers as possible before replying. Further, it would seem that such information should be requested and required as an integral part of the report. Given any of the desired information, an answer is no longer a guess.

A common thread actually can be found to be woven through these diverse reactions to ostensibly the same information. It is the processing by the human mind, which is influenced by the totality of previous experiences. It is precisely the diversity of responses from the mental processing of the information which distinguishes a human from a statistical or mathematical process.

Thus, in analyzing the responses to this simple example, a partial answer to the question of replacing managers with statistical models has been obtained. There is no way to model completely the reaction of any individual to a single event, let alone a series of events. This would apparently sound the "death knell" to the dreams of computer scientists who envision totally self-contained decision-making MIS.

The inability to model completely a self-contained system does not mean that research and development of computerized MIS and decision-making should be abandoned. No system has been modeled "completely" or exactly. Almost all equations used in the physical sciences are first order approximations, but this has in no way lessened their usefulness in advancing the understanding of physical phenomena. Thus, it is both egotistical and self-defeating to reject mathematical models as a tool because the process is too complex to be modeled exactly. However, it is also foolhardy to confuse the model with reality and blindly accept the solution to some equations as the absolute answer to an actual problem. In most cases, a workable answer should exist somewhere between these two extremes.

Another part of the answer is that "intuition" usually is not sufficient to provide an answer. Intuition provides an immediate guess, based on very few facts. What is needed is a careful consideration of the problem, the data, and the consequences; this process results in "insight." It is the insight gained through experiences of the decision-maker and not intuition which is the major contribution of the person to the

process. A successful manager, then, should not be one who guesses right 51% of the time, but one who relies on guessing the least amount of the time. Thus, insight is the process which should be addressed by the information specialists when attempting to develop algorithms and models of decision processes. The distinction between "intuition" and "insight" is of prime importance.

B. INSIGHT

Most books and articles relating the success, or more likely, the failures in the implementation of Management Information Systems stress two factors as most important:

1. Involvement and backing of top management; and

2. Communication between management and the computer or information specialist.

However, in the context of this thesis, it appears that an equivalent, if not more appropriate identification of the factors is:

1. The misunderstanding and misapplication of scientific methods; and

2. The basic differences in personality inherent in managers and computer scientists.

The mental process usually associated with problem-solving and decision-making is referred to as intuition or insight. These two words are used interchangeably as if they were equivalent. However, as shown in the preceding example, the two are not identical. For the purposes of this thesis, a differentiation between the two terms will be made as follows:

intuition - the unconscious use of the subconscious processing of information;

insight - the conscious use of the subconscious processing of information.

The coining or defining of a word cannot in itself change many years of traditional behavior, personality and personality conflicts, etc. However, it appears that it is exactly the misunderstanding between these two terms which has created part of the problem in developing an MIS. This misunderstanding has developed from the attempt to apply scientific methods to managerial decisions with the use of an information system.

To confuse scientific method with the equations and computations and the formal presentations is to confuse ritual with results. It is much like the "sight reading" phenomena foisted upon the schools by the educators. It was found that the best readers, when tested, apparently used the "sight method"; thus, to improve the reading level of the other students, they too, were started with the "sight method." Thus, phonics and all other aspects of learning to read were ignored. It was finally discovered that the fast readers had merely accelerated the preliminary phases of learning and had not skipped them. Thus, an important aspect of learning is "when." Just as in learning to drive an automobile, what to do is easy to learn, accelerate or brake; when you do either is a complicated function of the circumstances. While a theoretical algorithm might be derivable, the vast number of different circumstances, including the reaction capabilities of the drivers, precludes any attempt at quantitative directions. The application of "when" to the use of

scientific method comes not in the data gathering and manipulation, but in the coordination and analysis of the relationships of the events. It is not the ability to write down the ritual of problem solving and do it "by the numbers," that should be applied to management. It is innovation, acceptance of failure as part of the process, and serendipity--the ability to recognize the unexpected result--which will truly aid management. At this time, failure flies in the face of the profit-motivated attitude of business (in fact the attitude of the public in general). But, again, it is the "when" of the failure which is important. It should be during the planning and simulation phases (these are equivalent to the experimental phases in science), so that the chances of failure during the implementation phase is minimized. Thus, risk and failure are not synonymous.

There are two features of science, or more properly man's knowledge of science, that are sometimes overlooked. One is approximation, and the other is insight. It is actually the complex combination of these two which yields the advances in science. While analytic equations and mathematical solutions provide an aura of precision and exactness, this is a false impression. Duhem [7] describes the development process:

> (There are) four fundamental operations in a physical theory: (1) the definition and measure of physical magnitudes; (2) the selection of hypotheses; (3) the mathematical development of the theory; (4) the comparison of the theory with experiment.

Each of these is limited in accuracy in a very interdependent manner. The preliminary experiments and even some of the subsequent ones are limited by the engineering capabilities of the

time. Also, the mathematical solution is obtained using the techniques available. Thus, most physical theories are first or second order approximations. Even if the experimental error could be completely eliminated (which is impossible), problems still remain. First, the totality of interrelations producing the physical phenomenon are never completely known and modeled. Second, there may not exist the mathematical techniques required to solve the more complicated formulation. There are two outstanding examples of the approximation nature of physics. d'Abro [5] relates:

> There is no more simple law in physics than that of perfect gases; and yet we know that this apparent simplicity is due to our macroscopic observations and that it conceals the most bewildering chaos and uncertainty.

Also, the equations of motion for a falling rock are approximate. They apply only to a point mass falling in a vacuum. Once the actual physical dimensions and the air resistance are introduced, the formulation and the solution become approximate.

Thus, progress in knowledge in science is a complex leapfrog of improved engineering, improved analytic models, and improved mathematical processes; all of which are still approximations, with each following from and producing innovations in the others. The process which produces the improvements in science is also complex. As Duhem [7] describes it:

> Between the phenomena really observed in the course of an experiment and the result formulated by the physicist, there is interpolated a very complex intellectual elaboration which substitutes for the recital of concrete facts an abstract and symbolic judgement.

After many years of continued and continuous improvement in a particular area, there is usually some large jump, followed

by another period of relative continuity which fills in the connecting data. The realization of the need for new theories does not follow directly from preceding information, but is not totally divorced from it. The "overnight" successes in science usually result from a long period of consideration of previous information and as an attempt to remove apparent contradictions.

This part of the progress in improvement in science can best be classified as "insight." The importance of insight has long been recognized by the scientific community. As Duhem [7] relates:

> When Newton was asked how he went about making a discovery, he replied: 'I keep the subject constantly before me, and I wait until the first glimmer begins to dawn slowly and gradually, and changes into full daylight and clarity.'

d'Abro relates that with respect to Einstein [5]:

> It is not his knowledge of mathematics or of physics that causes admiration, it is his insight into the philosophy of nature which is stupendous.

However, d'Abro also cautions:

> Einstein argues from the standpoint of the physicist, but the opinions will certainly be endorsed by pure mathematicians. They, more than all others, have been led to realize how cautious we must be of the dictates of intuition and so-called common sense.

The importance of insight, rather than intuition was also found in the study of Eiduson [8]:

> While many anecdotes of great creatives have suggested the emergence of "inspiration" ... and have perpetuated the notion that creative thinking often occurs away from the work table, even such dramatic "break-throughs" are shown upon closer scrutiny to occur only after periods when concentration has been intense, where intellectual work has been purposeful, rational, and logical. There has usually been dogged persistence, tedious effort, and a clinging to long-sighted goals.

Management theorists have also recently discovered the importance of insight, or at least the failure of intuition. Drucker [6] has the following observations:

> Creativity, if by that is meant undirected, unstructured, untutored, and uncontrolled guessing, is not likely to produce results. ... The best proof that creativity is no substitute for analysis and knowledge are the experiences of those enterprises which were expropriated by governments with the professionals either expelled or leaving. ...
>
> Most managers know they need better tools. Most have learned by bitter experience that intuition is unreliable, if not downright treacherous, if used as the only basis for decision. ... Complex systems actually behave 'counter-intuitively.'

Thus, scientists, psychologists and some management theorists have seen the appropriateness for insight, as differentiated from intuition, in the decision process. However, the computer specialist dealing with most managers has perceived a preponderance of the use of intuition. Since intuition usually is not compatible with optimization, the computer scientist has striven to formalize the entire process, and at least obtain a mathematical optimization. Such optimization, relying totally on algorithms rarely produces acceptable real-world results. Thus, a commitment by top management may well obtain a computerized system. As noted by Argyris [2], "Theory X managers use Theory X^2 to bring about change." However, without the realization of the need for the inclusion of the contribution of the insight of the manager, the result may very likely be either little more than an automated accounting system, or, at the other extreme, a fully automated decision system based on totally inadequate models. Conversely, most managers will

have to be alerted to having more information available with which to make the decision, and attempting to follow some systemized approach.

As to the communication problem, Drucker [6] states:

> Communication presupposes common understanding and a common language, and it is precisely that which is usually lacking.

Research, particularly as exemplified by Eiduson [8] has revealed that, indeed, scientists and businessmen do have fundamentally different personalities. One basic difference is a greater reliance on insight by the scientist and on intuition by the businessman. It will take more than a Data Processing course for managers and a Theory of Management course for programmers, to provide a common base for understanding of the information required to aid in managerial decision-making, and the capabilities of information systems to process that information. The differences in personality and background lead to misunderstandings and different interpretations of the same words. A key word in the communication process is "insight."

The vibrant environment of the manager has now been described, together with the diversity of resources available with which to perform the varied functions. Information systems have been shown to be simultaneously a cause for a changed environment, a prime resource, and in some cases, a great hinderance. This is because much of the potential contribution of the MIS has been diminished by the conflicts which have arisen, particularly due to the differences in objectives and

attitudes of the information specialists and the managers. In their zeal to aid in the management decision process, the information specialists have misapplied scientific methods. In some instances this has occurred because the managers have obviated their position of responsibility and control for the system.

Finally, it has been shown that insight is the key element in decision-making; and that it is the recognition of the importance of insight by both managers and information specialists which is paramount in the development stages of MIS. Conversely, the functioning MIS is essential to the manager in the acquisition of insight for the performance of decision-making.

VI. RESULTS, CONCLUSIONS, AND RECOMMENDATIONS

The original purpose of this study was to have been the development of a pragmatic, operational procedure to improve the participation of managers in the development of a Management Information System, and thus, increase the contribution of the MIS to the management decision procedures. This could not be done to any satisfactory degree. However, since Eiduson's study on personality differences [8] was published in 1962, and Argyris' article on the problems in implementing systems [3] was published in 1970, and the problems still remain in 1976, it is not too surprising that an explicit solution was not obtained.

As a beginning toward a solution, two definitive problem areas were identified and explored: 1) the communication problem caused by the inherent differences in personality between scientists and managers, and 2) the problems caused by the confusion of intuition for insight as a procedure for management decision-making. The result of these two problems has manifested itself as misapplication of scientific methods to management.

In preparing background information necessary to place these topics in perspective, certain ideas became apparent. Questions regarding the philosophical basis for management theory and application had to be resolved before any resolution of these problems could be attempted.

The complexity of decision-making required the use of information from a variety of sources. The agreement between writers in such diverse disciplines as scientific philosophy, psychology, and psychiatry and contemporary management theory was startling. Whether or not these consistencies were the result of coincidence of natural agreement is almost impossible to determine. One thing which became evident was the documentation of misuse of scientific methods as applied to management by the computer and information specialists.

Textbook expositions of scientific or mathematical theories make it appear that the development always follows a fixed, sequential pattern of assumption and definition, theorem and proof. Biographical and historical reports show the true jagged, sporadic route that is usually followed. There are many false starts, blind alleys, then somehow a filling in of the missing pieces. Then, and only then, does the logical sequence become apparent. Any applicability of scientific methods has been seriously confused by the social scientists, who declare management problems to be too complex, individual, and unique to be solved (exactly) by mathematical models. At the other extreme they cannot be solved by the computer specialists, who purport to be able to solve the problems of the ages with algorithms.

The developers of MIS, particularly the information specialists, may have fallen into a trap. The most practical applied aspect of physical science is engineering. Thus, ultimately the manager should be in the same relative position relative to theories of management as the engineer is to natural sciences, particularly physics. It appears that in the desire to provide

the tools for management, rather than a parallel development or adaptation of the scientific method, the engineering approach was adapted directly. This would be a natural tendency since both disciplines pride themselves on their practicality. Thus, rather than a theory of management decision-making, there has been in reality only an "engineering." For this approach to work, this would presuppose that there is a direct correlation between the theories of natural science and the theories of management decision-making, which then allows direct adoption of engineering techniques by managers.

The computer specialists have thus committed two errors. First, in trying to apply scientific methods directly to management decision-making; second, in misunderstanding the scientific methods they have attempted to apply. The computer specialist is not totally to blame for the failure of MIS. There has been the accepted tradition that management decision-making usually has a short time frame. Thus, some optimization computation which could be performed in the time allotted was developed. In the name of practicality and expediency, problems were not formulated nor were solutions developed in a consistent manner. Rather, they were usually developed by ad hoc and at times haphazard procedures. Also, the insistence on exactness, the confusion in computational accuracy, and the inadequacy of the model are common failings not restricted to developers of MIS.

The preceding problems, and a great number of the problems with MIS are attributed to a problem in "communication." This

thesis has attempted to show that it is an inherent difference in personality between scientists and managers which creates this communication gap. The study of Eiduson [8] has identified basic differences; knowledge of these differences should allow the information specialists and the managers to develop areas of common understanding. Thus, the first step should be an education of both information specialists and managers of the results of personality tests such as Eiduson's.

One final observation is appropriate. The list of characteristics describing self-actualized persons appears to correlate very highly with the attributes compiled by Eiduson, particularly those attributes which differentiated scientists from businessmen. From this, it would appear more difficult for the manager to perform in a self-actualized level while at work. In fact, some attributes such as transcending the environment rather than coping with it, are in direct conflict with major functions of a manager. Whether this is true, or whether Maslow had an unconscious (or conscious) bias toward scientists, thus presenting characteristics more suitable to scientists, is a point of curiosity. If, indeed, the businessman cannot perform in a self-actualized mode while on the job, this could account for a frustration which could be a partial reason for conflicts.

APPENDIX

CHARACTERISTICS AND ATTRIBUTES

I. EIDUSON [8]

A. THOUGHT PROCESSES

The following is a complete list of the characteristics of the thought processes of scientists:

(1) He seeks to depart radically in his expressions and thinking from the usual, obvious, or hackneyed.

(2) He displays novelty in ideational activity.

(3) He shows an unusual emphasis in his thinking in the elaboration of fantasy.

(4) He shows a richness in his symbolic and descriptive expressions and associations.

(5) He has the capacity for recombining and reorganizing familiar concept.

(6) He accepts reality but sees it in a way different from others.

(7) His intellectual development is broad and he displays a diversity of interests.

(8) His interests point to the theoretical and abstract rather than to the practical and realistic.

(9) He prefers complex ideas and situations rather than simple ones.

(10) He seeks out delicate and subtle impressions and is usually responsive to sensory experience data.

(11) He can tolerate ambiguities and perception.

(12) He can loosen or relax controls in thinking without showing personality disorganization.

B. PERSONALITY

The following is a complete list of the characteristics of the personality of scientists:

(1) The scientist has strong emotional leaning to intellectual activity.

(2) He is independent in his thought and actions; and does not mimic others.

(3) He is challenged by frustration and anxiety-producing situations.

(4) Curiosity is likely to be a major determinant in his work.

(5) Strong ego involvement and conflict are expressed in work.

(6) He does not use parental ideals to set up his own goals.

(7) He shows a strong capacity for sensual gratifications.

(8) He is motivated by a desire to master or interpret natural forces or reality.

(9) He is sensitive to the moods and feelings of others.

(10) He is sensitive to his internal environment, needs, wishes and desires.

(11) He values work primarily as permitting expression of inner personality.

C. TEST RESULTS

The following is a list of significant differences in response of scientists and businessmen:

Thinking and Perception Variables

A. Items achieving a significance level of .05 or smaller:

Seeks to depart radically in his expressions and thinking from the usual, obvious, or hackneyed.

Can loosen or relax controls in thinking without personality disorganization.

Shows richness in symbolic and descriptive expression and association.

Interests point to the theoretical and abstract rather than the practical and realistic.

Has capacity for recombining, reorganizing visual conceptions.

Displays novelty in ideational activity.

B. Items achieving a significant level of .10:

Accepts reality but sees it in a way different from others.

Can tolerate ambiguities in the perceptual area.

Is responsive to sensory experience data.

Emotional Variables

A. Items achieving a significance level of .05 or smaller:

Shows a strong tendency for sensuous gratification.

Has strong emotional leanings for intellectual activity.

Imitates and depends on others in thinking and action (reverse scored).

Is challenged by frustration and anxiety-producing situations rather than being overwhelmed by them.

B. Items achieving a significance level of .10:

Is sensitive to the moods and feelings of others.

Is sensitive to his internal environment, needs, wishes, desires.

Motivational Variables

A. Items achieving a significance level of .05 or smaller:

Curiosity likely to be a prominent determinant of work.

Uses parental ideals to set his own goals (reverse scored).

Seems to be strongly self-directed and self-disciplined.

Strong ego involvement and conflict expressed in work.

Motivated by a desire to master or interpret natural forces or reality.

B. Items achieving a significance level of .10:

Values work primarily as permitting expression of inner personality.

II. MASLOW

A. HIERARCHY OF NEEDS

The following is the hierarchy of needs as developed by Maslow:

1. Physiological needs;
2. Safety, stability and security;
3. Self-esteem (ego-need) and the esteem of others;
4. Self-actualization, fulfillment of the person's potential and interests.

B. CHARACTERISTICS OF SELF-ACTUALIZATION

The following is a list of characteristics of self-actualized persons:

They are realistically oriented.

They accept themselves, or other people, and the natural world for what they are.

They have a great deal of spontaneity.

They are problem-centered rather than self-centered.

They are autonomous.

They have an air of detachment and a need for privacy.

Their appreciation of people and things is fresh rather than stereotyped.

Most of them have had profound mystical and spiritual experiences, although not necessarily religious in character.

They identify with mankind.

Their values and attitudes are democratic.

They do not confuse means with ends.

Their sense of humor is philosophical rather than hostile.

They have a great fund of creativeness.

They resist conformity to the culture.

They transcend the environment rather than just coping with it.

III. SAYLES [10]

A. MYTHS

The following is a list of management myths:

1. A manager should take orders from only one man, his boss. (Most managers, in fact, work for, i.e., they respond to the initiation of many people who are customers for the services they render or who are in a position to make demands upon them.)

2. The manager does work himself only under exceptional circumstances; the good manager gets all his work done through the activities of his subordinates. (The manager himself must carry on many of the relationships with "outsiders" in order to negotiate for the materials and services he receives and to

participate in the procedures by which his activities are evaluated by specialized groups in the organization.)

3. The manager devotes most of his time and energy to supervising his subordinates. (The need to interact with many groups outside his own keeps the manager away from subordinates a significant portion of the time.)

4. The good manager manages by looking at the results. (The modern organization has so many interdependent parts that the manager could not wait for results if he wanted to; others who were being affected would be at his door. But even without these pressures, the costs of waiting to find out "how things are going" until the results are seen would be enormous. Furthermore, most "results" are joint products and cannot be assessed against a single individual. Consequently, methods of continuous feedback are required.)

5. To be effective, the manager must have authority equal to his responsibility. (A manager almost never has authority equal to his responsibility; he must depend on the actions of many people over whom he has not the slightest control.)

6. Staff people have no real authority since they are subsidiary to the line organization. (Staff groups have very real power.)

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